PERFORMANCE OF STEERS FED PEANUT HULLS AS ROUGHAGE

Weight Gains and DDT Residues

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Weight Gains and DDT Residues

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Abstract

One hundred sixty crossbred steers were fed peanut hulls (PH) and corn silage (CS) as roughage in growing and finishing rations. Growing rations were computer-formulated to contain 30% roughage (dry weight) as follows: lot 1, 30% CS; lot 2, 20% CS:10% PH; lot 3, 10% CS:20% PH; lot 4, 30% PH. Average daily gains (kilograms) and feed efficiencies (kilograms dry-matter intake per kilogram gain) for the 93-day growing phase were 1.20, 7.9; 1.06, 8.8; 0.98, 9.2; and 1.10, 7.6, respectively. For the finishing phase (124 days) rations were formulated to contain 12% roughage (dry weight) and assigned as follows: lot 1, 12% CS; lot 2, 6% CS:6% PH; and lots 3 and 4, 12% PH. Average daily gains and feed efficiencies were 0.86, 8.6; 0.93, 7.6; 1.04, 7.1; and 0.91, 7.1, respectively. Although the level of DDT increased in the tissues with increasing amounts of peanut hulls fed, it did not exceed 0.41 μg/g at the end of the finishing phase, considerably below the Environmental Protection Agency tolerance of 5.0 μg/g DDT in the fat of red meat. The steaks from steers fed the various rations did not differ in flavor. These results indicate that peanut hulls are a satisfactory and economical roughage source for beef cattle.

Introduction

Approximately 475,000 tons of peanut hulls are available annually in the South as a byproduct of the peanut-shelling industry (7, 8).[2] Most hulls are burned, but the industry has been notified that disposal which does not pollute the atmosphere must be employed.[3] A potential use is as roughage in cattle feed. Compared with other roughages, peanut hulls contain considerably more fiber and are high in lignin (9). Hence, they are low in digestibility, and their primary value would be as nonnutritional roughage.

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[2]Underscored numbers in parentheses refer to items in "Literature Cited," p.

[3]John W. Greene, executive director, Southeastern Peanut Association, Albany, Ga. Personal communication, March 13, 1973.

DDT residues have limited the use of peanut hulls in beef cattle rations. During the 1960's, DDT in peanut hulls ran as high as 10 μg/g; however, since Federal registration for use of DDT on most commodities, including peanuts, was canceled on January 1, 1973, levels have dropped to generally less than 1.0 μg/g (F. E. Barton II, unpublished data). Their potential as a roughage factor in cattle rations has therefore increased.

The purpose of this study was to determine the performance of cattle fed various levels of peanut hulls in both growing and finishing rations under commercial feedlot conditions and to assess the potential problem of pesticide accumulation in various fatty tissues.

Experimental Procedures

One hundred sixty crossbred steers (three quarters Hereford-Angus, one quarter Brahman) weighing approximately 234 kg each were immunized against infectious bovine rhinotracheitis, bovine viral diarrhea, and *Clostridium novyi, C. chauvoei*, and *C. septicium* and were wormed with Thiobendazol. Intramuscular injections of vitamins A, D, and E were also given.

Tissue biopsies for pesticide analysis were taken from the right flank of forty steers selected at random. DDT and other chlorinated hydrocarbons in tissue samples and peanut hulls were analyzed by standard Food and Drug Administration procedures (3). All samples were analyzed on a Perkin-Elmer 900 gas chromatograph equipped with a ^{63}Ni electron-capture detector. Operating temperatures were as follows: column, 225°C; injector, manifold, and detector, 300°C. Flow rates were 80 ml/min through the detector and 40 ml/min through the column. A 3% SE-30 on 60/80 Chromosorb W AW/DMCS column, 305 by 0.32 cm, was used, with 90% argon-10% methane as the carrier gas.

Before the feeding started, one biopsied steer died and another was removed because of lameness. The remaining 38 biopsied steers were randomly placed in 4 lots (8 in one and 10 in the others). The 120 steers not biopsied also were equally divided at random among these 4 lots.

Each lot was fed one of four growing rations (table 1). The rations, computer-formulated on an as-fed basis, were designed to meet minimum National Research Council requirements for net energy for production, minerals, vitamins A, D, and E, and protein for growing beef cattle (4). The concentrate portion of all rations was premixed and then blended with the corn silage and peanut hulls. The final ration mixtures contained a 30% roughage factor (dry weight) from corn silage (CS), peanut hulls (PH), or combination thereof (where CS and PH each were given a roughage value of 1.0).

After 93 days, the growing phase, four of the biopsied steers were removed from each lot fed peanut hulls (lots 2-4) and killed. Samples of adipose tissue were taken from the flank, kidney knob, and heart cap of the warm carcass for pesticide analysis.

The remaining steers (38 from the lot fed CS and 36 from the lots fed PH) were fed finishing rations ad libitum for 124 days. These rations, computer-

formulated to National Research Council requirements (4), again contained CS or PH or both, but in amounts to give a 12% roughage factor, dry weight (table 2).

Daily feed consumption records were kept by lots. Each lot of steers was group-weighed initially and at 28-day intervals throughout the study, with a 3% shrink applied to live weights to correct for body fill. Steers had free access to water throughout both trials.

At the end of the finishing trial all animals were transported to a commercial packingplant, weighed individually, and then slaughtered. From the remaining biopsied cattle, flank, kidney knob, and heart cap tissues were again taken for pesticide analysis. In addition, all carcasses were graded for quality and yield by a USDA grader. Dressing percentages were calculated from hot-carcass weights.

Forty-eight hours after slaughter, the 11th and 12th ribs were removed for organoleptic analysis, and samples of rind fat were taken for pesticide analysis. A triangle test was used to evaluate flavor differences (5). One roast from each animal was cut into three steaks. Each steak was cooked to an internal temperature of 89°C in a rotary oven at 177°C.

Carcass and pesticide data were analyzed for significant differences by analysis of variance as outlined by Steel and Torrie (6), with differences between means determined by Duncan's new multiple-range test (1).

Results and Discussion

STEER PERFORMANCE

Table 3 shows performance data for the steers fed the growing rations for 93 days. Group weights were taken in accordance with the procedure followed by the commercial feedlot. Thus, statistical analysis of performance data was not possible. Average daily gain (ADG) was highest (1.20 kg) in steers fed 30% CS (lot 1), followed closely by steers fed 30% PH (1.10 kg, lot 4). Feed efficiency (kilograms dry-matter intake per kilogram weight gain) was best (7.6) for the steers fed 30% PH (lot 4) and least (9.2) for the steers fed 20% PH:10% CS (lot 3).

Performance data for the steers fed the finishing rations for 124 days are shown in table 4. The steers in lot 3 (12% PH) had the highest ADG (1.04 kg), whereas steers in lot 1 (12% CS) had the lowest (0.86 kg). Feed efficiencies were highest for steers in lots 3 and 4 (7.1 kg), followed by those in lot 2 (7.6 kg) and lot 4 (8.6 kg).

Utley and McCormick (9) fed 68 yearling steers, weighing approximately 395 kg each, finishing diets containing 0% to 30% peanut hulls for 84 days. Calculated on unshrunk final weights, AGD's were less for steers fed an all-concentrate diet (1.23 kg) than for steers fed diets containing 10% (1.44 kg), 20% (1.49 kg), or 30% (1.48 kg) peanut hulls. Feed efficiency, however, was better for steers on the all-concentrate diet. Fontenot et al. (2) reported ADG's of 1.30 and 1.25 kg for steers receiving finishing rations containing

15% ground corncobs or peanut hulls, respectively. There also were no differences in grade, marbling, loin eye-muscle area, back fat thickness, or dressing percentage in their study.

Performance and carcass data for the entire 217-day feeding period are shown in table 5. Average total weight gains (approximately 217 kg) and average daily gain (approximately 1.00 kg) were essentially the same for all steers. The best feed efficiencies were for steers in lots 2 and 4, fed 10% PH:20% CS and 30% CS, respectively, during the growing phase, and 6% PH:6% CS and 12% PH, respectively, during the finishing phase.

Carcass grades for the steers in lots 3 and 4 were higher ($P<0.05$) than for steers fed the lowest percentages of PH (lot 2) or those fed CS (lot 1). There was no significant difference in yield grade or dressing percentages among the four lots.

FEED COST

Feed costs per kilogram of gain in the growing and finishing phases, and the total feeding period are presented in tables 3-5. In the growing phase the lowest cost ($0.47/kg) was obtained for lot 4, the steers fed 30% PH (table 3). In the finishing phase, the lowest feed cost ($0.43/kg) was obtained for steers in lot 3 (table 4), those fed 12% PH during the finishing phase and 20% PH:10% CS during the growing phase. This lot also had the lowest feed cost ($0.46) for the total feeding period (table 5).

DDT RESIDUES

The peanut hulls used in the rations contained 0.56 μg/g DDT. The level of other chlorinated hydrocarbon pesticides was 0.01 μg/g or less. DDT in the 40 biopsies taken at the start of the growing phase averaged 0.031 μg/g. Measurable amounts of chlorinated hydrocarbons were found in only 8 of the 40 biopsied samples; DDT in these samples averaged about 0.1 μg/g of adipose tissue. The level of other chlorinated pesticides including lindane, chlordane, heptachlor, heptachlor epoxide, dieldrin, endrin, and aldrin was less than 0.01 μg/g in the 40 initial samples.

DDT in various tissues at the end of the growing and finishing phases is shown in table 6. The levels increased progressively with increasing peanut-hull roughage. At the end of the growing phase, residual DDT ranged from 0.20 μg/g in the fat of heart tissue (lot 2) to 0.98 μg/g in kidney knob fat (lot 4). Amounts in tissue taken at the end of the finishing phase were markedly lower, however, ranging from 0.13 μg/g in kidney knob fat (lot 1) to 0.40 μg/g in the fat of heart tissue (lot 4). The rind fat of the steaks contained DDT levels ranging from 0.10 μg/g (lot 1) to 0.29 μg/g (lot 4). Although the animals were still depositing adipose tissue during the finishing phase, they consumed less peanut hulls, thus accounting for the dilution of residual DDT.

The amount of DDT accumulated was considerably below the Environmental Protection Agency tolerance of 5.0 μg/g in the fat of red meat. These findings

are in general agreement with those of Fontenot et al. (2), who reported very low levels of DDT (0.04 μg/g) in the tissues of 32 feeder steers fed 15% peanut hulls in a finishing diet for 109 days.

ORGANOLEPTIC ANALYSIS

The sensory evaluation revealed no significant difference ($P>0.01$) in flavor between steaks from steers on the corn silage or peanut hull rations.

CONCLUSION

This study indicates that peanut hulls are a satisfactory roughage for both growing and finishing beef cattle. Accumulation of DDT in the fat of tissues averaged less than 0.5 μg/g, which is considerably below the Environmental Protection Agency tolerance of 5.0 μg/g. Organoleptic analysis revealed no significant difference in flavor of steaks from steers fed diets containing peanut hulls or corn silage. At the present time, peanut hulls are not recommended for dairy cows; further work is needed to ascertain the levels which can be fed to dairy animals.

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TABLE 1.--*Percentage composition of steer-growing rations*[1]

Ingredient	Lot[2] 1 (30% CS)	2 (10% PH: 20% CS)	3 (20% PH: 10% CS)	4 (30% PH)
Corn silage............	50.00	33.33	16.67	0
Peanut hulls...........	0	10.00	20.00	30.00
Corn gluten feed........	21.62	37.87	52.00	48.35
Soybean meal (44%)......	19.70	9.12	0	0
Molasses (wet)..........	5.00	5.00	4.54	1.67
Animal fat..............	1.92	2.98	3.87	3.69
Ground limestone........	.70	.65	.60	.68
Salt....................	.49	.49	.49	.49
Ground corn.............	0	0	1.28	14.56
Trace-mineral premix[3]...	.05	.04	.04	.04
Vitamin premix[4].........	.51	.51	.51	.51
Vitamin premix[5].........	.01	0	0	0

[1]Values expressed on as-fed basis.

[2]CS = corn silage, PH = peanut hulls. Dry-weight basis.

[3]Provided the following minerals per kilogram of premix: calcium, 240 g; copper, 22 mg; and zinc, 1 g.

[4]Provided the following vitamins per kilogram of premix: vitamin E, 1,320 IU; vitamin A, 2,495,000 IU; and vitamin D, 1,130,000 IU.

[5]Provided the following vitamins per kilogram of premix: vitamin A, 22,000,000 IU; and vitamin D, 4,400 IU.

TABLE 2.--*Percentage composition of steer-finishing rations*[1]

Ingredient	Lot[2] 1 (12% CS)	2 (6% PH: 6% CS)	3 and 4 (12% PH)
Corn silage...............	20.00	10.00	0
Peanut hulls..............	0	6.00	12.00
Ground corn...............	48.38	56.01	63.19
Soybean meal(44%).........	20.44	16.40	13.53
Cane molasses.............	5.00	5.00	4.43
Animal fat................	4.38	4.76	5.00
Ground limestone..........	.88	.86	.87
Defluorinated phosphate...	.07	.12	.14
Salt......................	.47	.47	.46
Trace mineral premix[3].....	.05	.05	.05
Vitamin premix[4]...........	.31	.31	.31
Vitamin premix[5]...........	.01	.01	.01

[1]Values expressed on as-fed basis.

[2]CS = corn silage, PH = peanut hulls. Dry-weight basis.

[3]Provided the following minerals per kilogram premix: calcium, 240 g; copper, 22 mg; and zinc, 1 g.

[4]Provided the following vitamins per kilogram premix: vitamin E, 13,200 IU; vitamin A, 2,495,000 IU; and vitamin D, 1,134,000 IU.

[5]Provided the following vitamins per kilogram premix: vitamin A, 22,000,000 IU; and vitamin D, 4,400 IU.

TABLE 3.--*Feedlot performance of steers fed peanut-hull and corn-silage roughage in growing rations*

[Growing phase: 93 days]

Lot.....................	1	2	3	4
No. steers..............	38	40	40	40
Roughage factor[1]........	30% CS	10% PH: 20% CS	20% PH: 10% CS	30% PH
Avg. initial wt., kg....	248	249	245	244
Avg. final wt., kg......	360	349	336	346
Avg. daily gain, kg.....	1.20	1.06	0.98	1.10
Kg dry ration/kg gain...	7.9	8.8	9.2	7.6
Feed cost/kg gain[2]......	$0.50	$0.52	$0.51	$0.47

[1]CS = corn silage, PH = peanut hulls. Dry-weight basis.

[2]Feed cost based on Atlanta market, July 27, 1971.

TABLE 4.--*Feedlot performance of steers fed peanut-hull and corn-silage roughage in finishing rations*

[Finishing phase: 124 days]

Lot....................	1	2	3	4
No. steers...............	38	36	36	36
Roughage factor[1].........	12% CS	6% PH: 6% CS	12% PH	12% PH
Avg. initial wt., kg.....	360	349	336	346
Avg. final wt., kg.......	466	464	464	459
Avg. daily gain, kg......	0.86	0.93	1.04	0.91
Kg dry ration/kg gain....	8.6	7.6	7.1	7.1
Feed cost/kg gain[2].......	$0.54	$0.52	$0.43	$0.47

[1]CS = corn silage, PH = peanut hulls. Dry-weight basis.

[2]Feed cost based on Atlanta market, July 27, 1971.

TABLE 5.--*Feedlot performance of steers fed peanut-hull and corn-silage roughage for growing-finishing period of 127 days*

Lot......................	1	2	3	4
Roughage Source[1]...........	CS	PH:CS	PH:CS	PH
Weight data:				
Avg. initial wt., kg.....	248	249	245	244
Avg. final wt, kg........	466	464	464	459
Avg. total wt. gain, kg..	218	215	219	215
Avg. daily wt. gain, kg..	1.00	0.96	1.02	0.96
Kg. dry ration/kg gain...	8.2	8.0	8.5	7.3
Feed cost/kg gain[2].......	$0.52	$0.52	$0.46	$0.47
Carcass data:[3]				
Dressing percentage[4].....	62.8a	62.6a	62.7a	62.7a
Carcass grade[5]...........	10.2a	10.4a	10.7b	10.6b
Yield grade[6].............	2.9a	3.1a	3.0a	2.9a

[1]CS = corn silage, PH = peanut hulls.

[2]Feed cost based on Atlanta market, July 27, 1971.

[3]Means in the same row followed by different letters are ;nificantly different, $P<0.05$.

[4]Hot-carcass dressing percentage.

[5]Carcass grade: 10, avg. good; 11, high good.

[6]Yield grade: 2 = 52.3% to 50.0% and 3 = 49.9% to 47.4% of :cass weight in boneless retail cuts.

TABLE 6.--*Residual DDT in tissues from steers fed rations containing corn silage and peanut hulls*[1]

[Micrograms per gram]

Lot	Growing phase[2]			Finishing phase[2]			
	Flank	Kidney	Heart	Flank	Kidney	Heart	Rind fat
1	(3)	(3)	(3)	0.15a±0.09	0.13a±0.09	0.16a±0.13	0.10a±0.09
2	0.23a±0.18	0.24a±0.18	0.20a±0.14	.20a± .06	.18a± .06	.22a± .12	.18a± .09
3	.60bc±.13	.79b± .14	.87b± .07	.24a± .16	.29a± .16	.29a± .15	.27a± .06
4	.96c± .07	.98b± .12	.90b± .18	.41a± .10	.38a± .13	.40a± .11	.29a± .06

[1]Error expressed as standard deviation.

[2]Means in columns followed by different letters are significantly different at $P<0.05$.

[3]Not determined.